

CLAIMS

What is claimed is:

1. A method for processing a substrate having hydrocarbons or other
5 airborne molecular contaminants residing thereon, the method comprising:
placing the substrate having a gate dielectric thereon in a process
chamber;
flowing an oxygen-source gas into the process chamber at a first
pressure;
10 forming a first plasma with the oxygen-source gas in the process chamber
at a first power for a first predetermined amount of time, therein combining the
hydrocarbons or other airborne molecular contaminants with oxygen species of
the first plasma to form product gases;
removing the product gases from the process chamber, therein reducing
15 an amount of hydrocarbons or other airborne molecular contaminants on the
substrate;
flowing a nitrogen-source gas into the process chamber at a second
pressure; and
forming a second plasma with the nitrogen-source gas in the process
20 chamber at a second power for a second predetermined amount of time, therein
nitriding the gate dielectric of the substrate.
2. The method of claim 1, wherein the oxygen species of the first
plasma comprises one or more species of oxygen gas radicals.
- 25 3. The method of claim 1, wherein the product gases comprise one or
more of carbon dioxide gas and hydrogen gas.

4. The method of claim 1, wherein the first predetermined amount of time is less than approximately five seconds.

5 5. The method of claim 1, wherein the first predetermined amount of time is generally dependent upon an amount of hydrocarbons on the surface of the substrate.

10 6. The method of claim 1, wherein the second predetermined amount of time is substantially longer than the first predetermined amount of time.

7. The method of claim 7, wherein the second predetermined amount of time is between approximately 10 seconds and 60 seconds.

15 8. The method of claim 1, wherein the second power is substantially greater than the first power.

9. The method of claim 1, further comprising annealing the substrate, wherein lattice damage is significantly repaired.

20 10. The method of claim 1, wherein the first pressure and the second pressure are between approximately 0.05 Torr and 2 Torr.

25 11. The method of claim 1, wherein removing the product gases from the process chamber comprises pumping down the process chamber to approximately 0 Torr.

12. A method for forming a transistor over a semiconductor substrate, the method comprising:

placing the substrate in a process chamber, wherein the substrate comprises a gate dielectric layer having a surface, and wherein one or more airborne molecular contaminants reside on the surface of the gate dielectric layer;

5 flowing an oxygen-source gas into the process chamber at a first pressure;

 forming a first plasma with the oxygen-source gas in the process chamber at a first power for a first predetermined amount of time, therein combining the one or more airborne molecular contaminants with oxygen species of the first
10 plasma to form one or more product gases; and
 removing the gases from the process chamber.

13. The method of claim 12, wherein the one or more airborne molecular contaminants comprise hydrocarbon contaminants, wherein the one or
15 more product gases comprise carbon dioxide gas and hydrogen gas.

14. The method of claim 12, wherein the first predetermined amount of time is less than approximately five seconds.

20 15. The method of claim 12, wherein the first predetermined amount of time is generally dependent upon an amount of hydrocarbons on the surface of the substrate.

16. The method of claim 12, wherein the first pressure is between
25 approximately 0.05 Torr and 2 Torr.

17. The method of claim 12, further comprising:
 flowing a nitrogen-source gas into the process chamber at a second pressure; and

forming a second plasma with the nitrogen-source gas in the process chamber at a second power for a second predetermined amount of time, therein nitriding the gate dielectric layer.

5 18. The method of claim 17, wherein the second predetermined amount of time is substantially longer than the first predetermined amount of time.

10 19. The method of claim 18, wherein the second predetermined amount of time is between approximately 10 seconds and 60 seconds.

20. The method of claim 17, wherein the second power is substantially greater than the first power.

15 21. The method of claim 17, wherein the second pressure is between approximately 0.05 Torr and 2 Torr.

20 22. The method of claim 17, further comprising annealing the substrate, wherein lattice damage is significantly repaired.